

CLAIMS

1. A printable composition, comprising:
 - a) a liquid carrier; and
 - 5 b) a plurality of nanostructures having an aspect ratio of at least about 5:1 within the liquid carrier.
2. The composition of claim 1, wherein the plurality of nanostructures are selected from the group consisting of nanobelts, nanoplates, nanodiscs,
10 nanowires, nanorods, and combinations thereof.
3. The composition of claim 2, wherein the plurality of nanostructures are selected from the group consisting of nanobelts, nanoplates, nanodiscs, and combinations thereof.
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4. The composition of claim 1, wherein the plurality of nanostructures are nanowires or nanorods.
5. The composition of claim 1, wherein the plurality of nanostructures
20 have an aspect ratio of at least about 10:1.
6. The composition of claim 5, wherein the plurality of nanostructures have an aspect ratio of from about 10:1 to about 5000:1.
- 25 7. The composition of claim 1, wherein the plurality of nanostructures are inorganic.
8. The composition of claim 1, wherein the plurality of nanostructures are doped.
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9. The composition of claim 1, further comprising a stabilizing agent configured to inhibit agglomeration of the plurality of nanostructures.

10. The composition of claim 9, wherein the stabilizing agent is selected from the group consisting of nanostructure surface attached ligands, nanostructure polymeric coatings, nanostructure metal coatings, nanostructure
5 surfactant coatings, and mixtures thereof.

11. The composition of claim 10, wherein the stabilizing agent is a nanostructure metal or metal oxide coating selected from the group consisting of Ag, Au, Pt, Pd, Ni, Co, SiO₂, Al₂O₃, AgO, and combinations thereof.

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12. The composition of claim 10, wherein the stabilizing agent is a nanostructure surface attached ligand selected from the group consisting of carboxylates, thiolates, alkoxides, alkanes, alkenes, alkynes, diketonates, siloxanes, silanes, germanes, hydroxides, hydride, amides, amines, carbonyl,
15 nitriles, aryl, and combinations thereof.

13. The composition of claim 10, wherein the stabilizing agent is a nanostructure surfactant coating.

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14. The composition of claim 1, further comprising a molecular precursor.

15. The composition of claim 14, wherein the molecular precursor is a metal salt selected from the group consisting of organometallic complexes, inorganic complexes, and inorganic salts.

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16. The composition of claim 1, wherein the plurality of nanostructures comprise from about 1 wt% to about 70 wt% of the printable composition.

17. The composition of claim 1, further comprising a colorant.

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18. The composition of claim 1, wherein said liquid carrier is a liquid vehicle, and the printable composition is ink-jetable.

19. The composition of claim 18, wherein the plurality of nanostructures comprise from about 1 wt% to about 40 wt% of the printable composition.

5 20. The composition of claim 1, wherein the liquid carrier includes a solvent having a boiling point greater than 90°C.

21. A substrate having a printable composition printed thereon in a predetermined pattern, said printable composition including:

- 10 a) a liquid carrier; and
 b) a plurality of nanostructures having an aspect ratio of at least about 5:1 within the liquid carrier.

22. The substrate of claim 21, wherein the plurality of nanostructures are
15 selected from the group consisting of nanobelts, nanoplates, nanodiscs, nanowires, nanorods, and mixtures thereof.

23. The substrate of claim 21, wherein the plurality of nanostructures have an aspect ratio of at least about 10:1.

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24. The substrate of claim 21, further comprising a stabilizing agent configured to inhibit agglomeration of the plurality of nanostructures.

25 25. The substrate of claim 24, wherein the stabilizing agent is selected from the group consisting of nanostructure surface attached ligands, nanostructure polymeric coatings, nanostructure metal coatings, nanostructure surfactant coatings, and mixtures thereof.

26. The substrate of claim 21, wherein the substrate comprises a member
30 selected from the group consisting of ceramics, polymers, cellulose, glass, silicon, organic substrates, metal oxides, and mixtures or composites thereof.

27. The substrate of claim 21, wherein the plurality of nanostructures are sintered on the substrate.

28. A method of forming a conductive ²⁷path on a substrate, comprising:
5 a) applying a printable composition onto a substrate, said printable composition including:
i) a liquid carrier; and
ii) a plurality of nanostructures having an aspect ratio of at least about 5:1 within the liquid carrier; and
10 b) removing at least a portion of the liquid carrier,
wherein the plurality of nanostructures are in sufficient contact to provide the conductive path.

29. The method of claim 28, wherein said nanostructures are a member
15 selected from the group consisting of nanobelts, nanoplates, nanodiscs, nanowires, nanorods, and mixtures thereof.

30. The method of claim 28, wherein the plurality of nanostructures have an aspect ratio of greater than 10:1.
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31. The method of claim 28, wherein the printable composition further comprises a stabilizing agent configured to inhibit agglomeration of the plurality of nanostructures.

25 32. The method of claim 28, wherein the substrate comprises a member selected from the group consisting of ceramics, polymers, cellulose, glass, silicon, organic substrates, metal oxides, and mixtures or composites thereof.

30 33. The method of claim 28, further comprising heating the substrate sufficient to sinter the plurality of nanostructures.

34. The method of claim 33, wherein said heating is performed at from about 150 °C to about 900 °C.

35. The method of claim 28, wherein the conductive path is a trace,
5 transistor, resistor, inductor, gate, diode, capacitor, magnet, and combinations thereof.

36. The method of claim 35, wherein the conductive path has a linewidth
10 of from about 15 μm to about 100 μm .

37. The method of claim 28, wherein said printable composition is applied using a technique selected from the group consisting of ink-jetting, screen printing, gravure printing, embossing, offset printing, and roller coating.

15 38. The method of claim 37, wherein said technique is ink-jetting.

39. The method of claim 38, wherein said ink-jetting is performed using an ink-jet printhead having an orifice size of from about 15 μm to about 100 μm .

20 40. The method of claim 39, wherein said plurality of nanostructures have an average length which is from about 5% to about 80% of the orifice size.

41. A system for forming conductive paths on a substrate, comprising a
printhead having a firing chamber reservoir containing an ink-jetable
25 composition, said ink-jetable composition including a liquid vehicle; a plurality of nanostructures having an aspect ratio of at least about 5:1 within the liquid vehicle; and a stabilizing agent configured to inhibit agglomeration of the plurality of nanostructures.

42. A printable composition, comprising:

- a) a liquid carrier;
- b) a plurality of nanostructures having an aspect ratio of at least about 5:1 within the liquid carrier; and
- 5 c) a stabilizing agent configured to inhibit agglomeration of the plurality of nanostructures.

43. A printable composition, comprising:

- a) a liquid carrier;
- 10 b) a plurality of nanostructures having an aspect ratio of at least about 5:1 within the liquid carrier; and
- c) a molecular precursor.